Make Life Easy

Coupler manual

Field Network Devices

ARIO-C-PB (ProfiBus)

MOO-ARIOCPBU-V1.2-2103US

Thank you for purchasing an Autonics product.
This user manual contains information about the product and its proper use,
and should be kept in a place where it will be easy to access.

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Preface

Thank you for purchasing Autonics product.
Please familiarize yourself with the information contained **in the Safety Considerations section** before using this product.
This user manual contains information about the porduct and its proper use, and should be kept in a place where it will be easy to access.

Coupler Manual Guide

- Please familiarize yourself with the information in this manual before using the product.
- This manual provides detailed information on the product's features. It does not offer any guarantee concerning matters beyond the scope of this manual.
- This manual may not be edited or reproduced in either part or whole without permission.
- This manual is not provided as part of the product package.
  Please visit our website (www.autonics.com) to download a copy.
- The manual's content may vary depending on changes to the product's software and other unforeseen developments within Autonics, and is subject to change without prior notice.
  Upgrade notice is provided through our homepage.
- We contrived to describe this manual more easily and correctly. However, if there are any corrections or questions, please notify us these on our website.

Coupler Manual Symbols

Symbol	Description
 **Note**	Supplementary information for a particular feature.
 **Warning**	Failure to follow instructions can result in serious injury or death.
 **Caution**	Failure to follow instructions can lead to a minor injury or product damage.
 **Ex.**	An example of the concerned feature's use.
※1	Annotation mark.

Safety Considerations

- Please observe all safety considerations for safe and proper product operation to avoid hazards.
- Safety considerations consist of 'warning' and 'caution. The following symbols represent caution due to particular circumstances in which hazards may occur.

Warning	**Warning**	Failure to follow instructions can result in serious injury or death.
Caution	**Caution**	Failure to follow instructions can lead to a minor injury or product damage.

Warning

- Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime/disaster prevention devices, etc.)
  Failure to follow this instruction may result in personal injury, economic loss or fire.
- Do not use the unit in the place where flammable/explosive/corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact, or salinity may be present.
  Failure to follow this instruction may result in explosion or fire.
- Do not disassemble or modify the unit.
  Failure to follow this instruction may result in fire.
- Do not connect, repair, or inspect the unit while connected to a power source.
  Failure to follow this instruction may result in fire.
- Check 'Connections' before wiring.
  Failure to follow this instruction may result in fire.

Caution

- Use the unit within the rated specifications.
  Failure to follow this instruction may result in fire or shortening the life cycle of the product.
- Use a dry cloth to clean the unit, and do not use water or organic solvent.
  Failure to follow this instruction may result in fire or electric shock.
- When connecting the power input and I/O wiring, use AWG 22~16 cable.
- After checking the connecting and removing the wire, use the crimp terminal.
- Failure to follow this instruction may result in fire or malfunction due to contact failure.
- Keep the product away from metal chip, dust, and wire residue which flow into the unit.
  Failure to follow this instruction may result in fire or product damage.
- Do not cut off power or disconnect connectors (or terminals) while operating the unit.
  Failure to follow this instruction may result in fire or product damage.

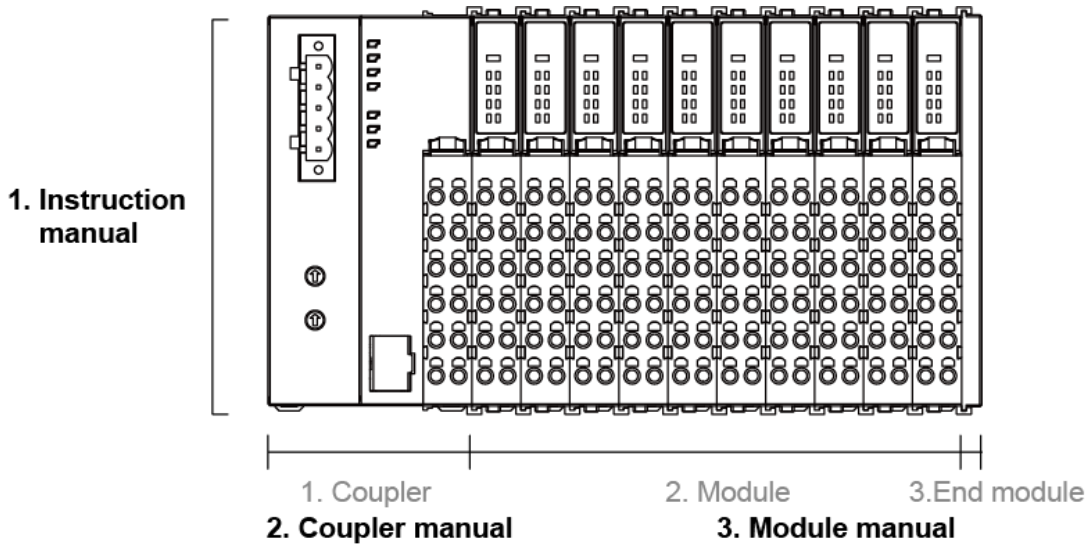
The specifications and dimensions of this manual are subject to change without any notice

Caution during Use

- Follow instructions in 'Caution during Use'. Otherwise, it may cause unexpected accidents.
- ABUS power and I/O power should be insulated by the individually insulated power device.
- Power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
- Use the rated standard cables and connectors. Do not apply excessive power when connecting or disconnecting the connectors of the product.
- Keep away from high voltage lines or power lines to prevent inductive noise.
- In case installing power line and input signal line closely, use line filter or varistor at power line and shielded wire at input signal line.
  For the stable operation, use shield wire and ferrite core, when wiring communication wire, power wire, or signal wire.
- Do not use near the equipment which generates strong magnetic force or high frequency noise.
- Do not touch the module communication connecter part of the base.
- Do not connect or remove the base while connected to a power source.
- For removing the terminal, body or base, do not operate units for a long time without it.
- This unit may be used in the following environments.
  ① Indoors
  ② Altitude max. 2,000m
  ③ Pollution degree 2
  ④ Installation category II

Table of Contents

1 Reference manuals



1.1 Instruction manual

It describes an overview of Remote I/O, definitions of terms, installation environment, mounting/removing method, wiring and troubleshooting.

1.2 Coupler manual

It describes the overview, specification, demensions, memory map and troubleshooting of each communication.

1.3 Module manual

It describes the demensions, specification, connections and diagnosis function of each module.

1.4 DAQMaster user manual

DAQMaster, a device integration management program, provides the expanded user convenience. You can use the module setting, real-time control, and monitoring/diagnosis function of input/output signal (except ARIO-C-PN and ARIO-C-PB). Also, you can arrange products through virtual mode and recommended sorting.

2 Overview

2.1 ProfiBus

ProfiBus realizes a bit-serial field bus based on the basic requirements of the field device interface. Field level consists of distributed peripherals that communicate with automation systems in real-time, such as I / O modules, measuring devices, drive units, valves, and operator terminals. Process data, parameters, and self-diagnosis data are transmitted cyclically.
ARIO-C-PB, ProfiBus-based coupler, synchronizes data from all connected I / O modules with ProfiBus. The coupler determines the physical structure of the node and automatically creates a local process image of all the I / O. It also includes a mixed arrangement of analog (word) and digital (byte) modules.
The process image is divided into input and output data areas.

3 Specifications

Model		ARIO-C-PB
Coupler type		ProfiBus DP-V1
Power supply※1	ABUS(external consump.)	24VDC⎓, max. 400mA (Max. 9.6W, Coupler+Module, max. 200mA/CH, 2CH/COM)
	ABUS(internal supply)	5VDC⎓, max. 960mA (max. 4.8W, module)
	I/O	24VDC⎓, max. 4,000mA (max. 96W, max. 2,000mA/CH, 2CH/COM)
Power consumption	Coupler	24VDC⎓ standby/run: 200mA, Max. load: 400mA (coupler max. load)
Internal communication	Protocol	ABUS protocol
	Transmission speed	4Mbps only
Memory※2	Input	244 byte
	Output	244 byte
Max. connections for modules※2		32 units
Higher-level protocols	Transfer rate	Max. 12Mbps※3
	Distance between Nodes	Max. 1200m※3
	Communication connector	9 pin D-Sub Connector
	Concurrent connection of Node	Max.127 Nodes (when using repeater)
	Node setting	Rotary switch for communication setting in ARIO (Station no.)
	Topology	Line
Installation method		DIN rail mounting
Setting and monitoring		PC connection with USB 2.0 Micro type connector (comprehensive device management program, DAQMaster)

;

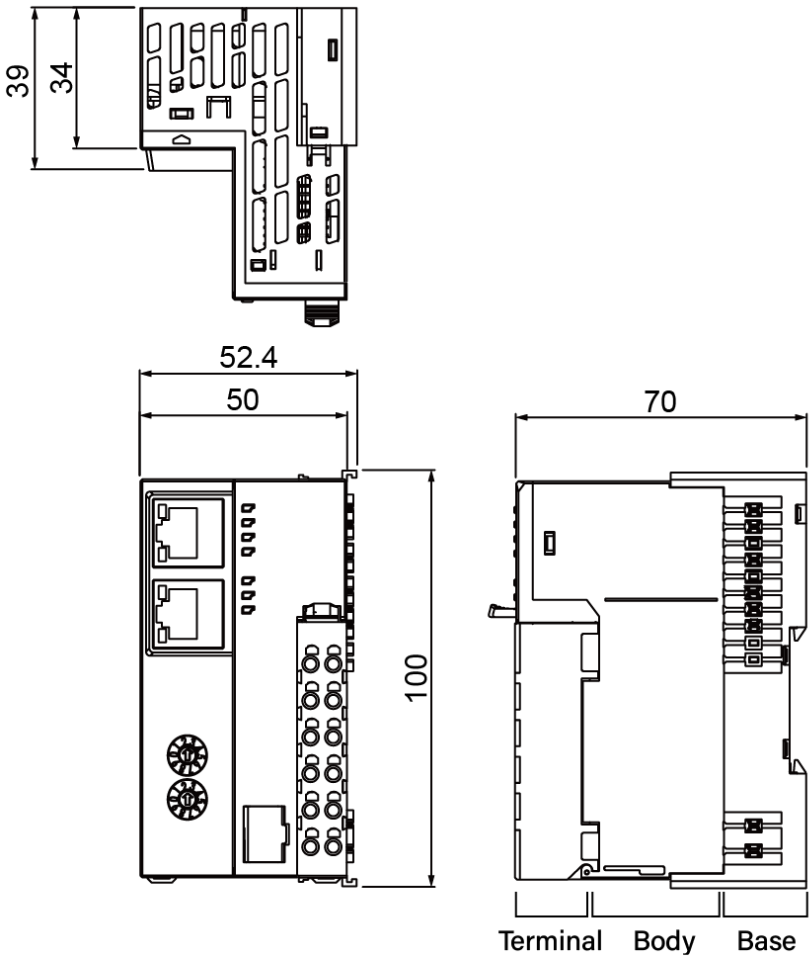
Model		ARIO-C-PB
Insulation resistance		Over 100MΩ (at 500VDC⎓ megger)
Dielectric strength		1000VAC 50/60Hz for 1 min
Noise immunity		±500V the square wave noise (pulse width: 1 μs) by the noise simulator
Vibration	Mechanical	0.7mm amplified at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 1 hour
	Malfunction	0.5mm amplified at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 10 min.
Shock	Mechanical	300m/s^2 (approx. 30G) in each X, Y, Z direction for 3 times.
	Malfunction	100m/s^2 (approx. 10G) in each X, Y, Z direction for 3 times.
Environment	Ambient temp.	-10 to 55°C, storage: -25 to 70°C
	Ambient humi.	35 to 85%RH, storage: 35~85%RH
Protection structure※4		IP20 (IEC standards)
Material		Terminal: polyamide6, Body: modified polyphenylene oxide, Base: polyamide6, poly oxy methylene
Approval		
Association approval		
Weight※5		Approx. 265g (approx. 165g)

※1. It is including power/special modules and excluding coupler/end modules. In case of one coupler module connecting, the ARIO digital module is available to connect up to 8 units, and the ARIO analog and special modules are available to connect up to 4 units. For connecting the modules, consider power concumption of the sensors and drivers connected the ARIO coupler
※2. If it over the limit size or connected units, system may be error.
※3. The maximum distance is determined by the transfer rate. Refer to “4.3.1 Switch for transfer rate.”
※4. Autonics test standard
※5. The weight includes packaging. The weight in parenthesis is for unit only.
※ Environment resistance is rated at no freezing or condensation.

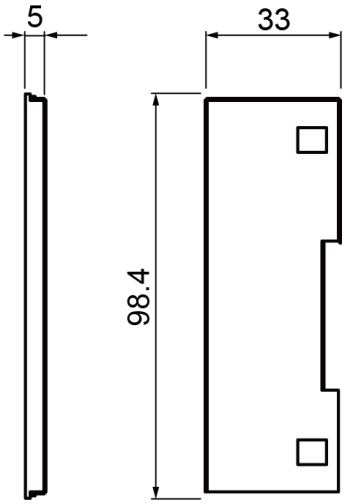
4 Hardware

4.1 Dimensions

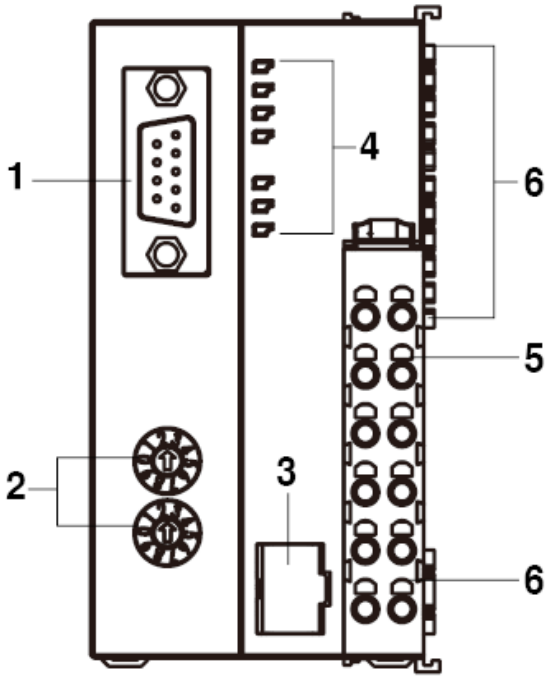
(1) Coupler



(2) End module



4.2 Unit descriptions



1. Communication connector: 9 pin D-Sub Connector
   : You can use a universal 9 pin D-Sub connector and cable, but we recommend using connectors and cables that are certified by the PIA (ProfiBus Association).
2. Communication setting switch (station no: X16, X1)
3. Setting connector (USB 2.0 type Micro B)
   : You can connect DAQMaster to configure and monitor.
4. Indicators for power and comm. status
   4-1 Internal / external state of coupler: Displays the input power / operation state of the coupler.
   4-2 State of Field network: Displays the operation of the field network.
5. Power terminal block
6. ABUS comm. connector: Input terminal that supplies circuit driving power of the coupler, ABUS, and modul by receiving 24VDC.
   I/O power supply : Supplies power for input / output signal of module by receiving DC, AC, etc.

4.3 Rotary switch for communication setting

4.3.1 Transfer rate

Set the data rate automatically.

Transfer rate (bps)	Distance between nodes (m)
9,600	1,200
19,200	
45,450	
93,750	
187,500	1,000
500,000	400
1,500,000	200
3,000,000	100
6,000,000	
12,000,000	

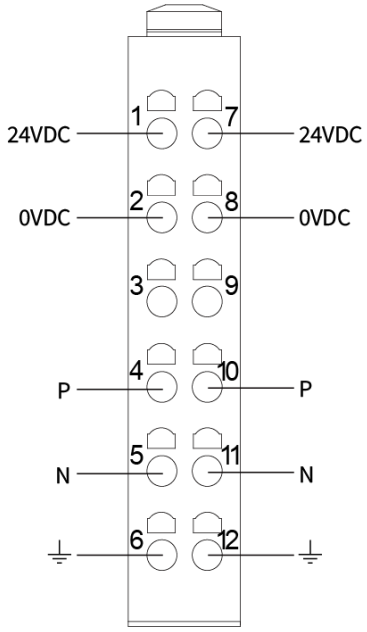
Do not use stubs at speeds above 1500kbps.

4.3.2 Switch for station no.

Switch		Description
	Station no.: X16	Use to distinguish the order (name) of couplers. Range: 01 to 127 • Node 0 is not normally used. • Node 1 and Node 2 are used as primary and secondary masters. • Node 126 is used as node setting address of software. • Node 127 is used for broadcast address
	Station no.: X1	

The rotary switch cannot be changed while the power is operating. To apply the changed rotary switch, the coupler must be turned on again.

4.4 Wiring diagram for power supply



Terminal No.	Descriptions
1, 7	System Power (24VDC)
2, 8	System Power (0VDC)
3, 9	N.C. (Not Connected)
4, 10	Field Power (24VDC, POS)
5, 11	Field Power (0VDC, NEG)
6, 12	Frame Ground / Shield

4.5 Status indicator

(1) Definition

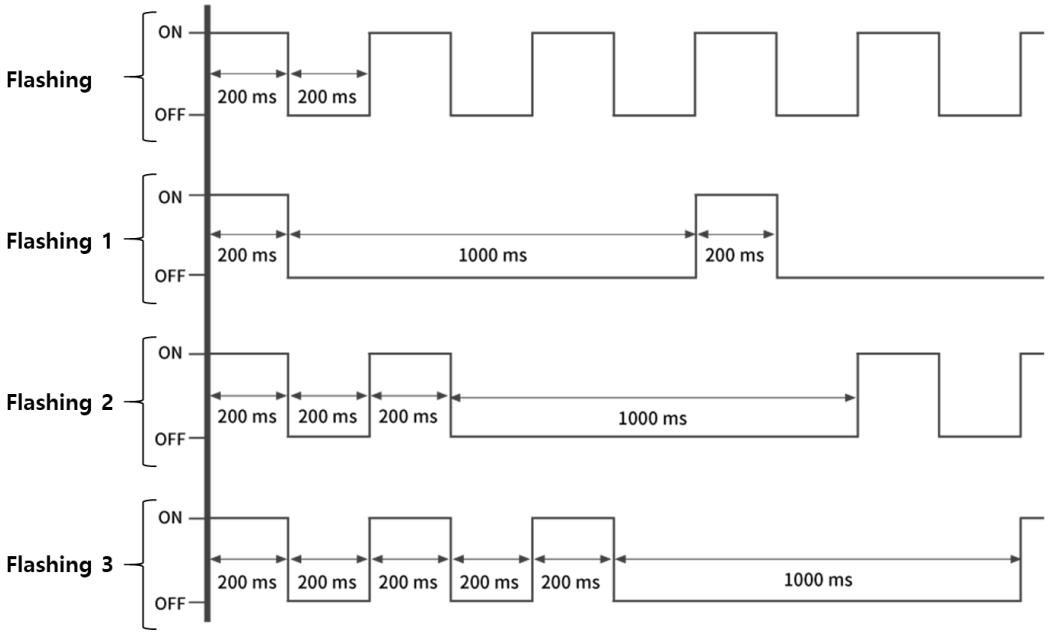
Indicator	Color	ON	OFF
POWER	Green	The power voltage of coupler is connected. (supply 24VDC)	No power supply
SYSTEM	Green	Normal operation (device on online state, communicating with master)	Stop operation
	Red	Failure to initialize coupler (recovery failed) Recovery error during the coupler operation (recovery failed) Difference between field network type and firmware version (recovery failed)	Normal operation
DIAG	Green	Normal operation (Multi Packet and Single Packet are operating)	Stop operation of coupler or in error condition.
	Red	Internal network (ABUS) inoperable state	Normal operation
IO POWER	Green	The I/O power voltage of coupler is connected. (supply 24VDC)	No power supply

(2) Status

Indicator	Color	Flashing	Flashing 1	Flashing 2	Flashing 3	Flashing 4
POWER	Green	—	—	—	—	—
SYSTEM	Green	Wait for connecting the master after coupler initialization completes	—	—	—	—
	Red	Change during Initializing coupler or rotary switch operation Field network initialization failed (recovery failed)	—	—	—	—
DIAG	Green	Hot-swap state (normal state)	—	—	—	—
	Red	Module, which different from the removed module, is inserted. (normal operation)	—	Initialization failure: There is no connected module.(recovery failed)	Initialization failure: abnormal module is operating (recovery failed)	Initialization failure: maximum module / data size exceeded
IO POWER	Green	—	—	—	—	—

Note

Following chart is a timing diagram of flashing -/1/2/3.



(3) Status of field network

LED	Color	Status	Description
SF/ BF	Green	OFF	Initialization state
		ON	Cyclic communication
	Red	OFF	No error
		Flashing (cyclic)	Communication stops, connection error
		Flashing (non- cyclic)	No configuration
		ON	ProfiBus DP slave configuration error

5 Memory map

5.1 Memory system

5.1.1 Data handling

classification	I/O type	Method of data handling
Bit	2 point/module	1 byte
	4 point/module	1 byte
	8 point/module	1 byte
	16 point/module	2 byte (= 1word)
byte	8 bit/channel	1 byte
	12 bit/channel	2 byte (= 1word)
	16 bit/channel	2 byte (= 1word)
	24 bit/channel	4 byte (= 2word)

The module manages arbitrarily transformed data based on its input/output type. It makes a waste of memory size, however, register position (such as PLC) can be easily calculated because the estimates of the data position are separated into the modules.

5.1.2 Data type

The data type can be expressed in the way of bit or byte unit. If the IO type is smaller than the method of data handling, the empty space of data is filled with 0. You can also set the arrangement method of analog data to Big Endian or Little Endian via DAQMaster.

- Bit unit: The value of the corresponding bit is expressed as '1'
- byte unit: The input value is expressed in each byte
- Factory settings of the coupler: Big Endian

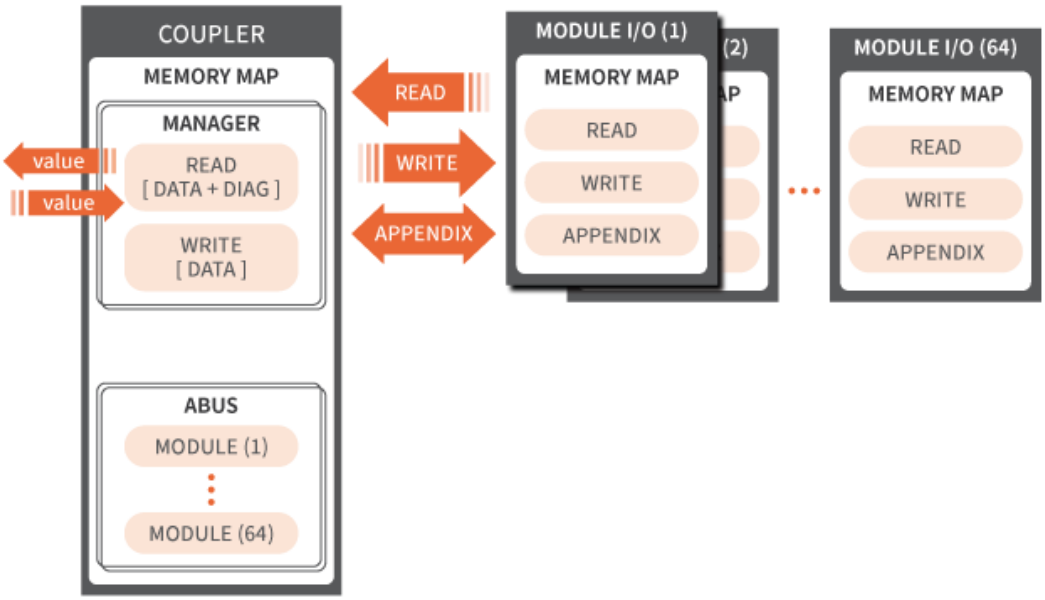
Ex.

- Data unit is the Bit, point 3 of the digital input module received the input signal
  - Data expression: 0b 0000 0**1**00 (0x04) (□□□□□■□□ = 0x04)

- Data unit is the byte, channel 1 of the analog input module received the input signal with 10.000V
  - Big Endian: 0x **27 10 (10,000)**
  - Little Endian: 0x **10 27 (4,135)**

- When the handling data of ARIO-S-DI04P is 4 bits
  - The input type of the module above is 4 bits, and the value is smaller than 1 byte (8 bit), which is the data handling method. So the coupler fills the □ area of □□□□BBBB with the number 0.
  - Data expression: 0b **0000** BBBB

5.2 Memory structure

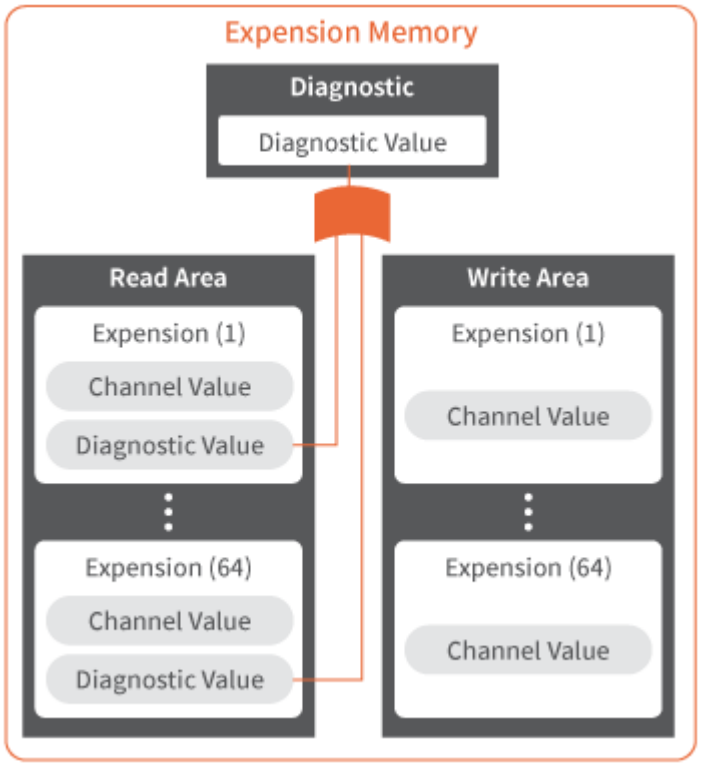


The memory structure manages each own area for couplers and modules are to efficiently manage data. This separates the coupler from the module's data area, making the module's data format has no limitation. It also helps the coupler and modules are freely add data if they have diagnosis function.
In other words, the coupler independently manages the module's data in an order that the modules are connected. And it provides information that appropriately processed, requested from the host device (master of field network or DAQMaster).
In addition, the coupler provides input and output information of the unit in accordance with the data size set in the field network. When the diagnosis function is activated, the coupler provides data embed with additional input area.

5.3 Memory area

Classification	Items	Description
Memory Management		Manage read and write data in order of module combination for providing information to field network
Fieldbus Memory	Read Area	Data area including the input data and diagnostic information, transmits the information collected from the remote IO unit to the master of field network
	Write Area	Data area including output data information, outputs information from the master of field network via the remote IO unit

5.4 Gather diagnostic information of modules



Save and Manage the information collected from each module in a contiguous memory. The read area includes diagnostic information as well as its own channel information. If the output module includes the diagnostic information, it provides the information by utilizing the read and write area at the same time.

The coupler transmits the diagnostic information of itself and modules to the master of field network according to the settings, which is cyclically updated. This information allows you to remotely check the status of each coupler.

5.5 Process image

When power is supplied, the coupler recognizes all connected modules.
The coupler organizes a memory map that takes into account the module's type / data size as well as the module's location, creating an internal process image. This area consists of the input and output data area, as mentioned before.
Since digital I / O modules are managed in bit format and analog I / O modules are managed in byte format, digital channels are grouped in byte units and add new bytes when they exceed 8 bits.

5.6 Example of memory map

5.6.1 Device

[0] ARIO-C-PB	ProfiBus Coupler
[1] ARIO-S-AO02V	2-channel analog output modules (AO)
[2] ARIO-S-DI04P	4-channel digital input modules (DI)
[3] ARIO-S-AI02V	2-channel analog input modules (AI)
[4] ARIO-S-DO04P	4-channel digital output modules (DO)
[5] ARIO-S-AI02V	2-channel analog input modules (AI)
[6] ARIO-S-DO04P	4-channel digital output modules (DO)
[7] ARIO-S-DI04P	4-channel digital input modules (DI)
[8] ARIO-S-DO08P	8-channel digital output modules (DO)
[9] ARIO-S-DI04P	4-channel digital input modules (DI)

This example shows the memory map that the coupler and module configure when the diagnostic function is activated. You can change the factory settings of the coupler via DAQMaster.

- Factory settings of the coupler
  - Diagnostic function: Inactivated
  - Endian: Big Endian

5.6.2 Input process image

Byte	.7	.6	.5	.4	.3	.2	.1	.0
0	High Byte of Coupler Diagnostic							
1	Low Byte of Coupler Diagnostic							
2					DI1P4	DI1P3	DI1P2	DI1P1※1
3	Analog input module 1, channel 1, High byte※2							
4	Analog input module 1, channel 1, Low byte※2							
5	Analog input module 1, channel 2, High byte							
6	Analog input module 1, channel 2, Low byte							
7	Analog input module 2, channel 1, High byte							
8	Analog input module 2, channel 1, Low byte							
9	Analog input module 2, channel 2, High byte							
10	Analog input module 2, channel 2, Low byte							
11					DI2P4	DI2P3	DI2P2	DI2P1
12					DI3P4	DI3P3	DI3P2	DI3P1

※1: DI1P1 stands for 1st Point of Digital Input Module 1.

※2: In the Little Endian, the process image is arranged in the order of Low byte → High byte.

5.6.3 Output process image

Byte	.7	.6	.5	.4	.3	.2	.1	.0
0	Analog Output module 1, channel 1, High byte							
1	Analog Output module 1, channel 1, Low byte							
2	Analog Output module 1, channel 2, High byte							
3	Analog Output module 1, channel 2, Low byte							
4					DO1P4	DO1P3	DO1P2	DO1P1※1
5					DO2P4	DO2P3	DO2P2	DO2P1
6	DO3P8	DO3P8	DO3P8	DO3P8	DO3P8	DO3P8	DO3P8	DO3P8

※1: DO1P1 stands for 1st Point of Digital Output Module 1.

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* Dimensions or specifications on this manual are subject to change and some models may be discontinued without notice.